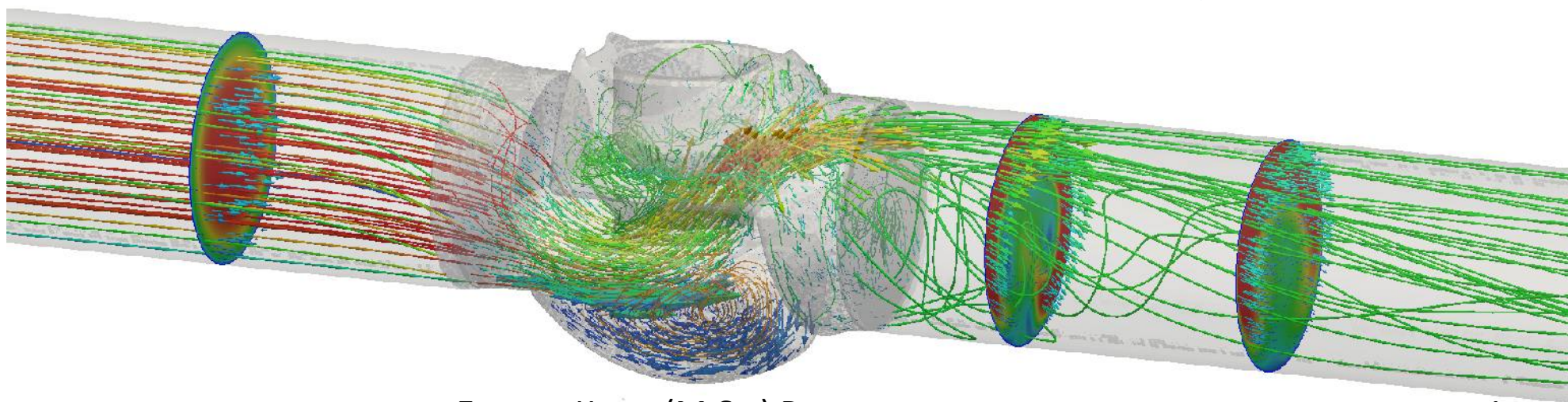




CFD study of flow through straight regulatory valve

Student: Dragan Kodžo

Mentor: PhD professor Aleksandar Ćoćić

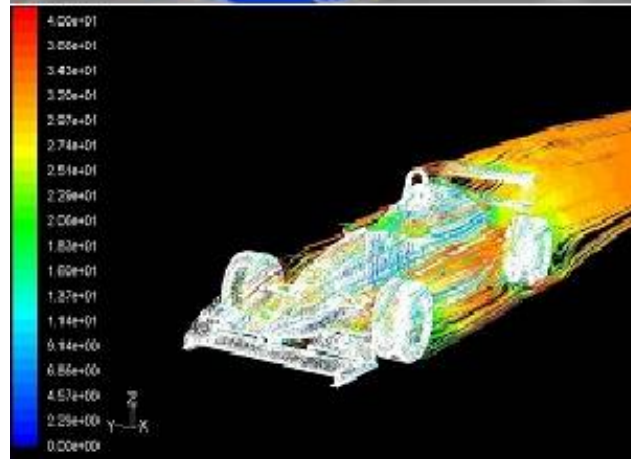
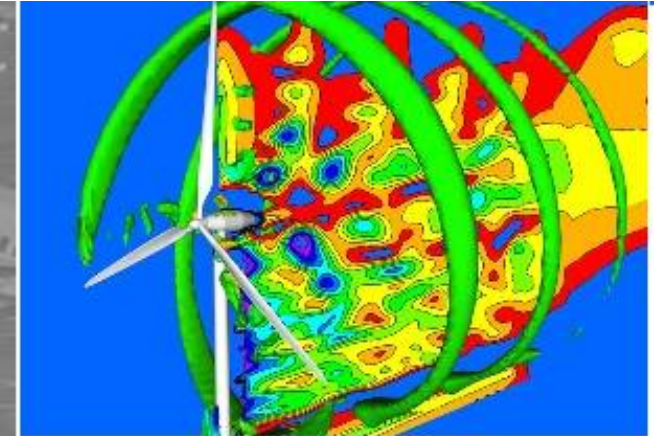
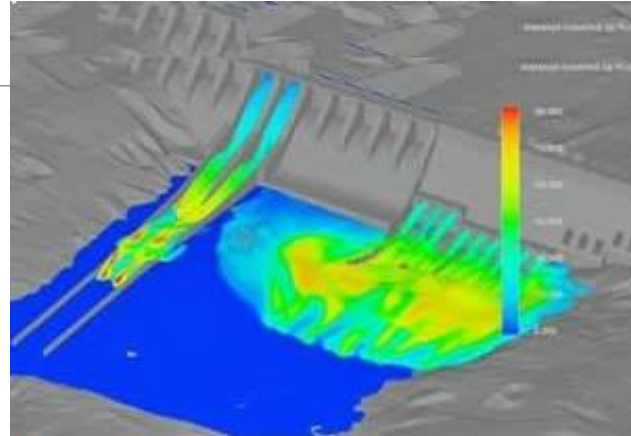


Computational fluid dynamics (CFD)

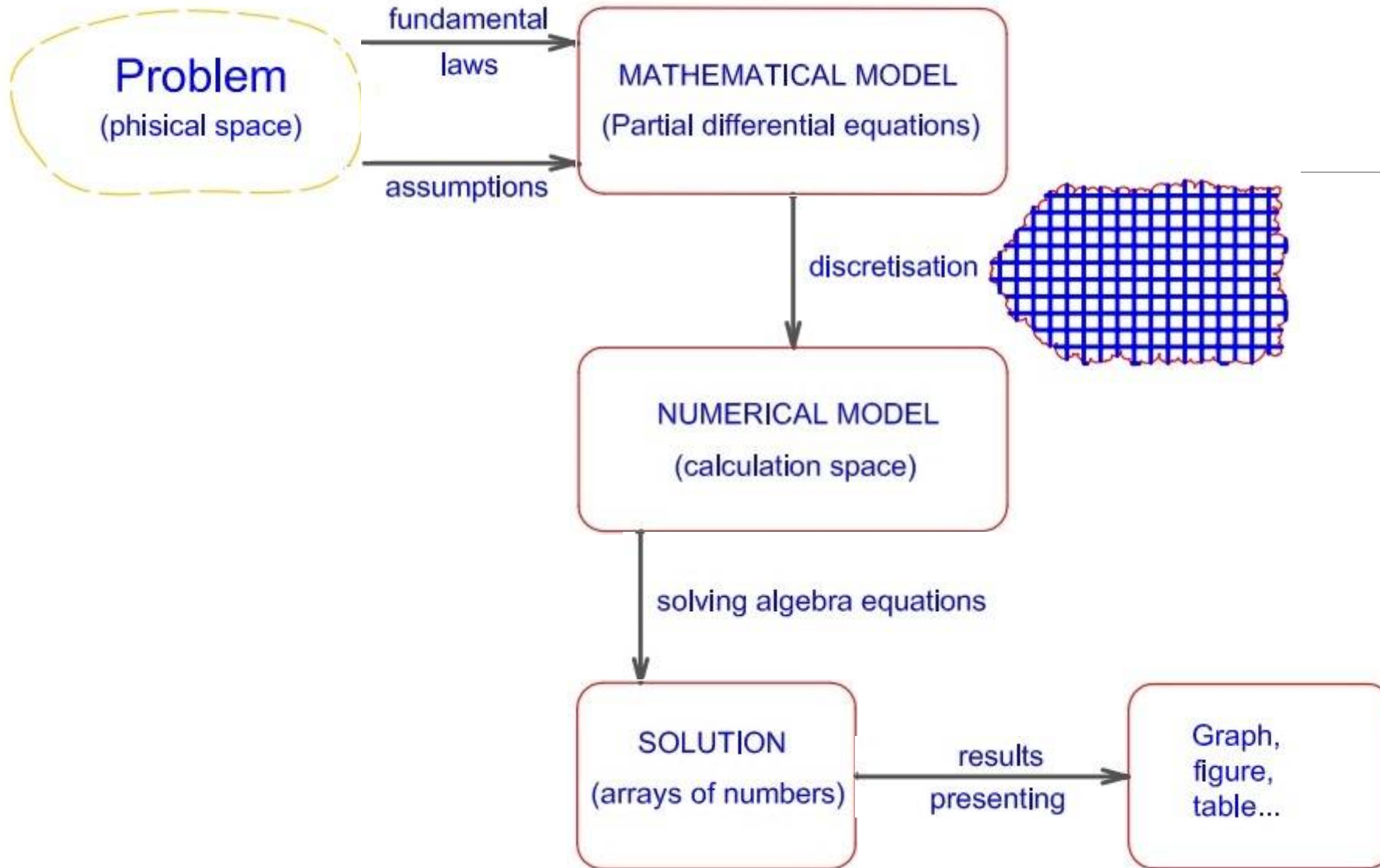
- Solving problems in fluid dynamics
- Equations in fluid dynamics
 - Conservation of mass (mass continuity)
 - Conservation of momentum (Navier-Stokes eq.)
 - Conservation of energy

About CFD

- Definition
- Applications:
 - Engineering
 - Medicine
 - Sport
 - Entertainment
- OpenFOAM software:
 - Found in 80's at Imperial college
 - Consists of many C++ libraries
 - GNU-General public license
 - Has many applications

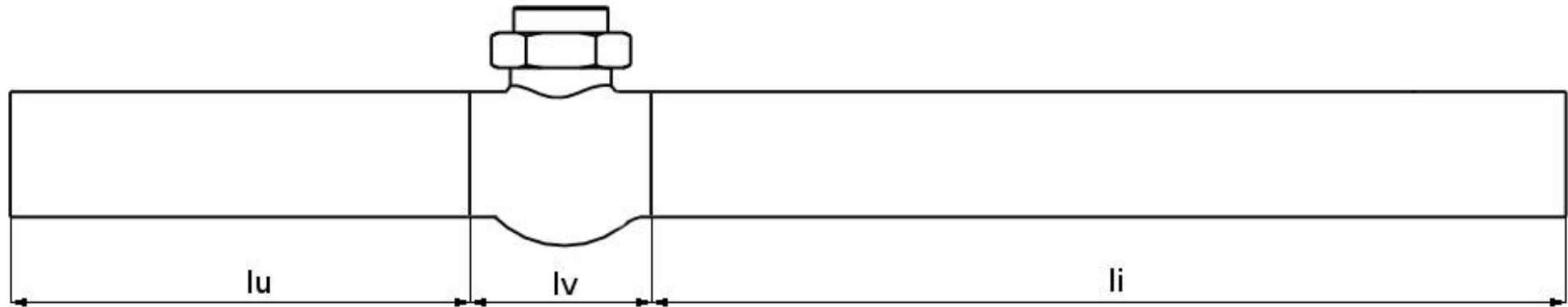


Schematic preview of steps in CFD:



Straight regulatory valve

- Definition
- Applications
- Pressure drop:
 - Experimental arrangement:



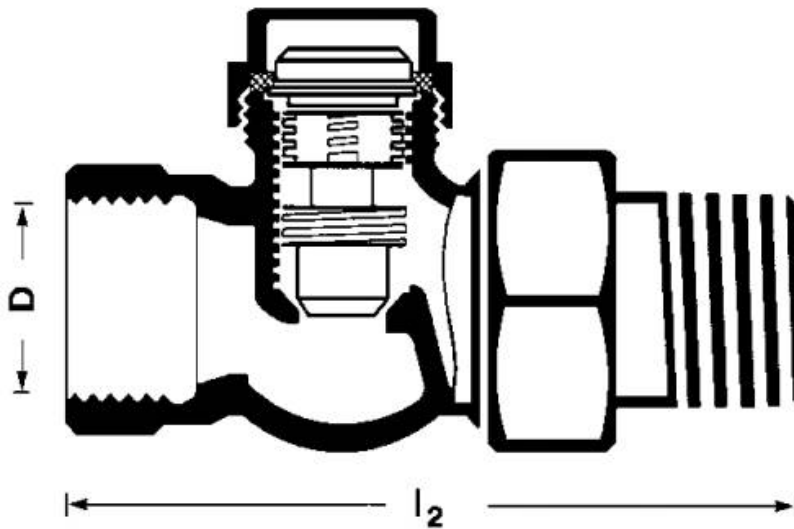
- Formula:

$$(\Delta p)_v = \rho \left[\left(\frac{\Delta p}{\rho} \right)_{uk} \frac{2}{u_{sr}^2} - \lambda_u \frac{l_u}{D} - \lambda_i \frac{l_i}{D} \right] \frac{u_{sr}^2}{2}$$

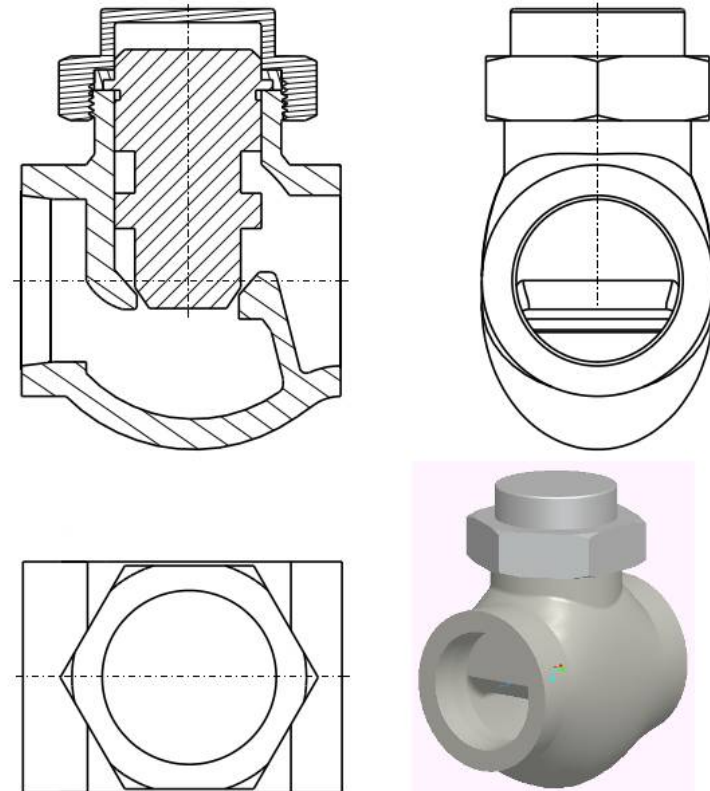
Straight regulatory valve

- Valve model

- Valve model from manufacturer's brochure:

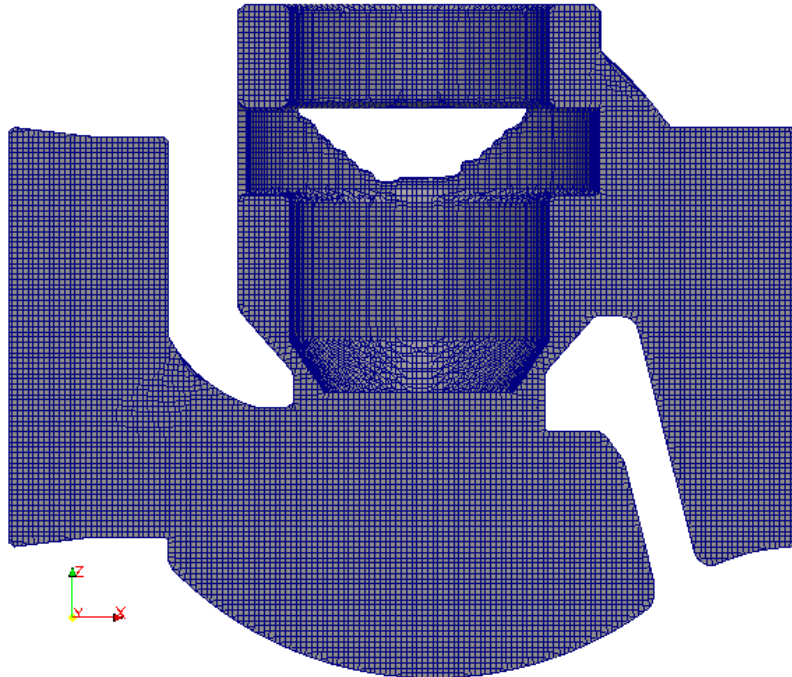


- Modelled model of valve:

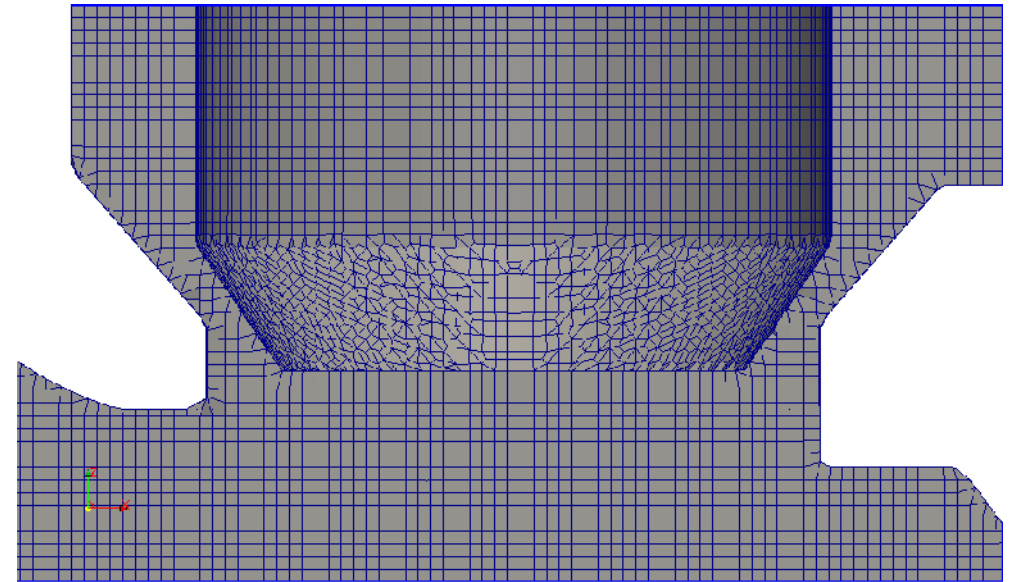


Straight regulatory valve

- Numerical mesh:
 - Numerical mesh for the most closed position of valve:



- Zoomed view of smallest gap:



Straight regulatory valve

- k-ε Turbulent model
- Assumptions for fluid
- Velocities of fluid trough valve:

	v [m/s]	qm [kg/h]
Velocity 1	0,08	75,56
Velocity 2	0,175	126,42
Velocity 3	0,35	252,842

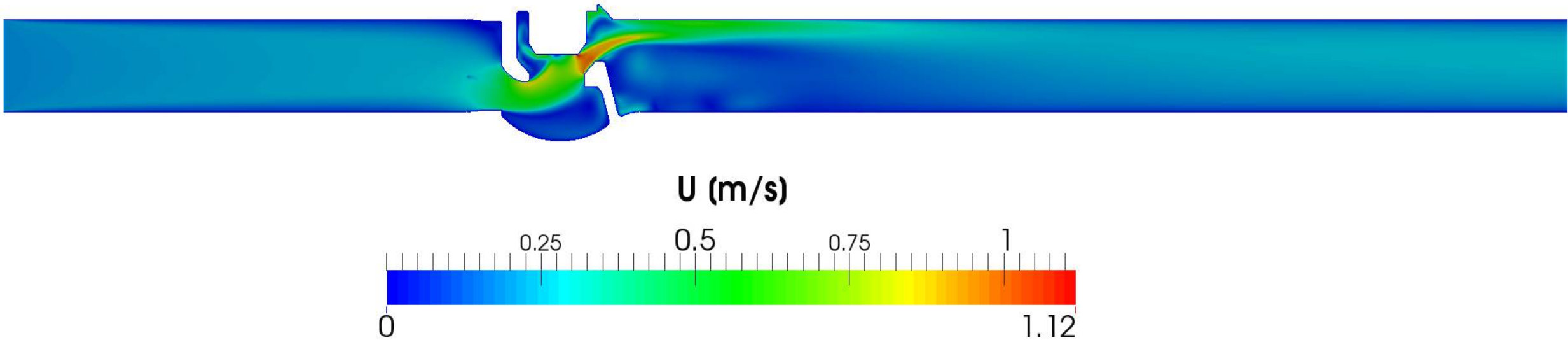
- Valve positions:

	s [m]
Position I	$s_I = s * 0,1 = 0,503 \text{ mm}$
Position II	$s_{II} = s * 0,5 = 2,515 \text{ mm}$
Position III	$s_{III} = s = 5,03 \text{ mm}$

Straight regulatory valve

- Results of numerical calculations:

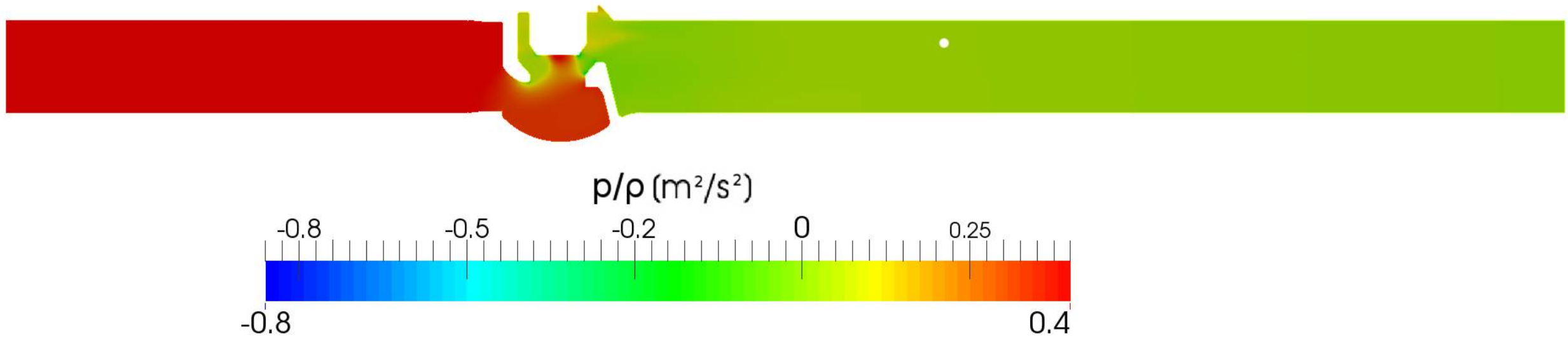
 - Velocity field for position III and velocity 2:



Straight regulatory valve

- Results of numerical calculations:

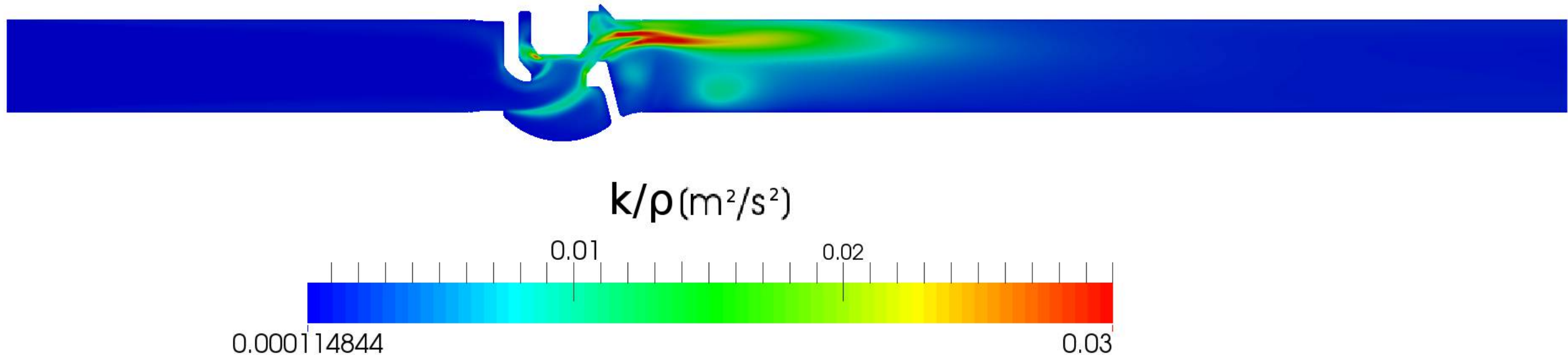
 - Pressure field for position III and velocity 2:



Straight regulatory valve

- Results of numerical calculations:

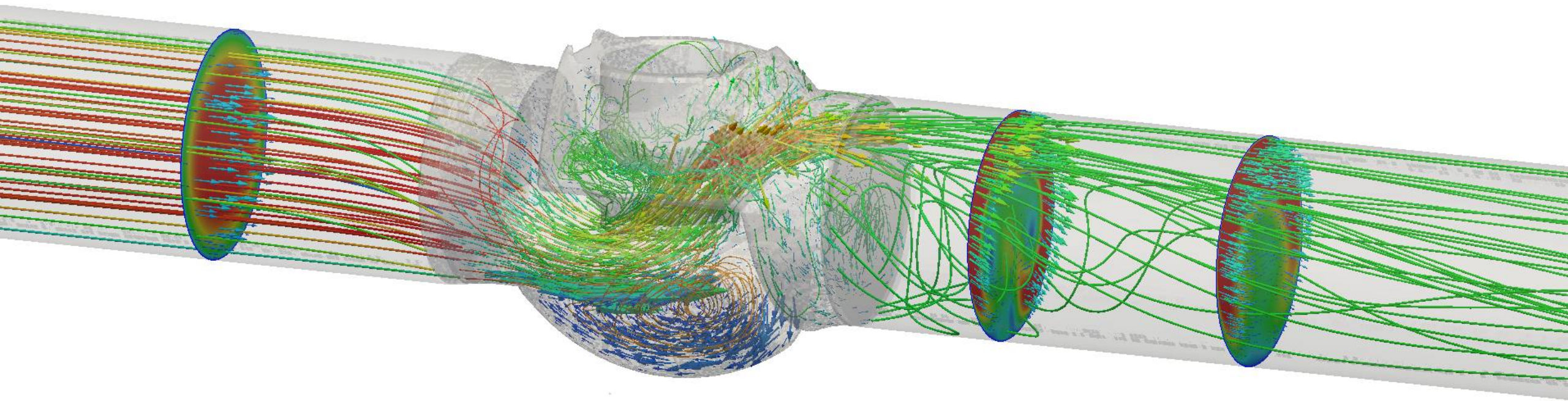
 - Turbulent kinetic energy field for position III and velocity 2:



Straight regulatory valve

- Results of numerical calculations:

 - Combined 3D preview of vectors and streamlines for position III and velocity 2:

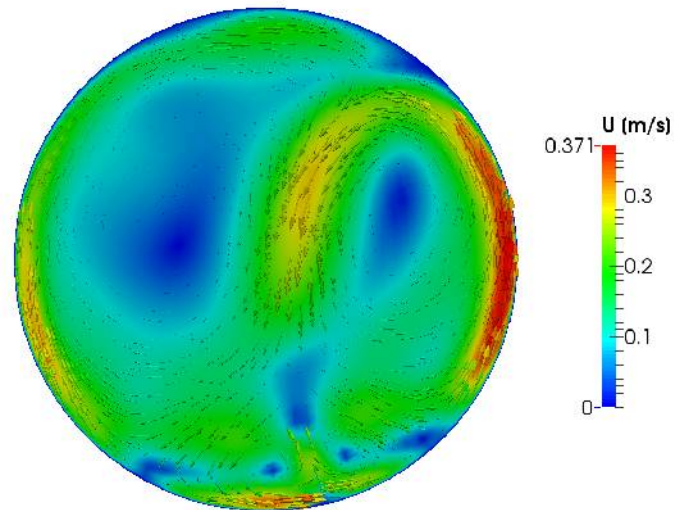


Straight regulatory valve

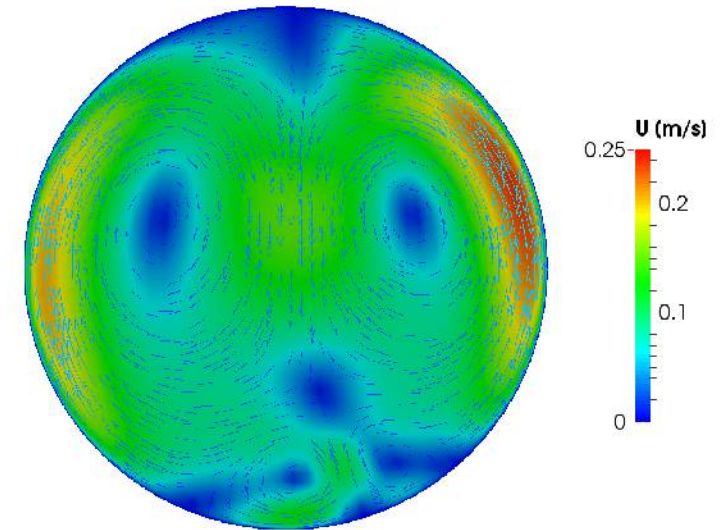
- Results of numerical calculations:
-

- Secondary flows behind the valve:

- Slice 2/3 d from end of valve:

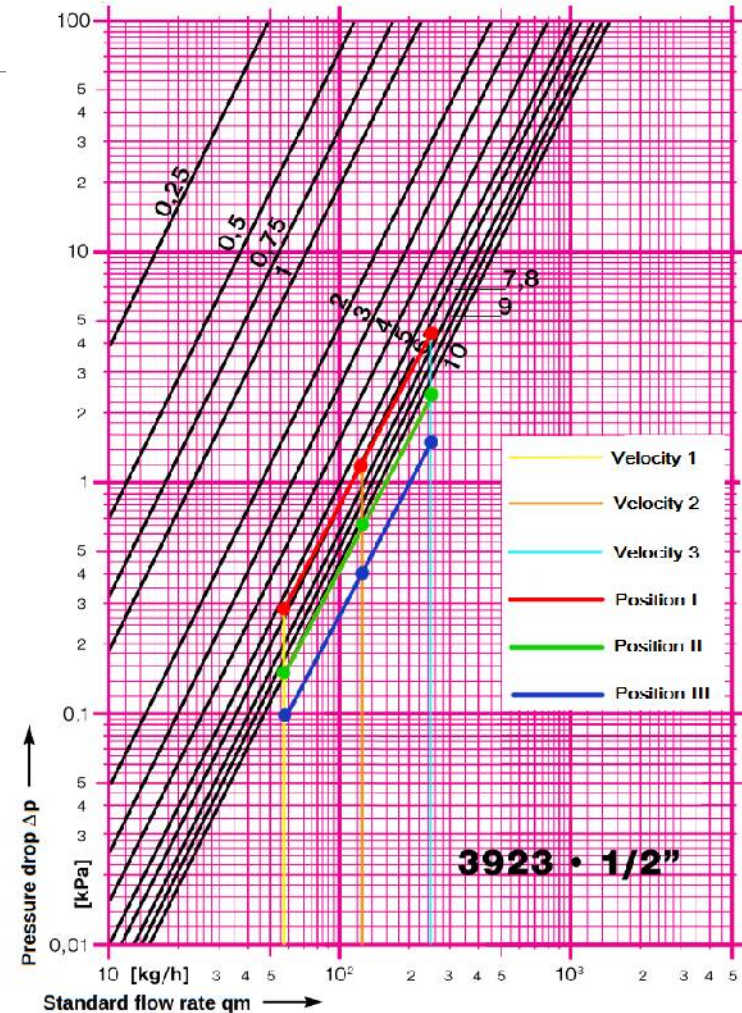


- Slice 1 d from end of valve:



Straight regulatory valve

- Results of numerical calculations:
-
- Pressure drop comparison to charts from manufacturer's brochure:



Thanks' on attention!!!